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UNITED STATES BUREAU OF MINES
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ACCIDENT EXPERIENCE OF THE COAL MINES OF UTAH FOR THE PERIOD 1918 TO 1929

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ACCIDENT EXPERIENCE OF THE COAL MINES OF UTAH FOR THE PERIOD 1918 TO 1929[1]

By A. L. Murray[2] and D. Harrington[3]

From 1870 to the end of 1929 the coal production of Utah has been somewhat less than 110,000,000 tons. During this period at least three major disasters have occurred with fatalities totaling about 380, establishing a decidedly bad record of approximately 3.5 persons killed by major mine explosions per million tons of coal produced. Even during the period when there have been no disasters, such as the years 1914 to 1920, inclusive, the fatalities in ordinary working were about 5.4 per million tons produced, against 3.7 per million tons for the whole United States for the same years. The 5-year period following the World War, 1918 to 1922, inclusive, had 4.7 fatalities per million tons; hence, the fatality record in the coal mines of Utah has uniformly been in excess of the average of the coal mines of the entire country.

Notwithstanding this poor record, Utah has given to the coal-mining world many excellent safety methods and practices, and Utah coal mines in general take greater measures toward safe mining than do the coal mines of any other State; if practices and methods allowed and pursued in coal mines of other States were tried in Utah coal mines, there would be a succession of disasters.

OPERATING CONDITIONS

Utah's principal producing coal mines, operated by about 23 companies and numbering 42 in 1929, have comparatively thick beds. Little coal under 5 feet thick is being worked and practically none under 4 feet; much, if not most, of the coal comes from beds in excess of 8 feet, some running as high as 30 feet. In thick beds in which coal is left on floor and roof, any dust found or made is entirely combustible. In addition, the thick beds induce the use of large-capacity cars, the handling of which in rooms and other workings on fairly heavy grades (up to 10 or 12 per cent) tends to cause haulage accidents. The thick beds give high ribs and roof, in which it is difficult to prevent slabs of coal or rock from dropping on workers and also difficult to keep free of gas and coal-dust. The coal has high volatile content, generally over 40 per cent and in some instances nearly to 50 per cent; hence it is highly inflammable. Most of the coals have large resin content, which is usually in dust form and hence is almost as inflammable as black blasting powder. At least one-third of the mines give off methane and several give off other inflammable gas with a gasoline or kerosene odor. Several mines have oil seepages in the roof or floor; in some instances, there is enough oil to necessitate frequent baling into barrels and removal from the mine. Some mines have a difficult safety, as well as efficiency, problem in the mining of two or more beds with only a few feet of rock between them, the rock thickness varying from place to place. Most of the mines are working under heavy cover, which approximates 3,000 feet in some instances and presents decidedly difficult problems in controlling roof. Probably the worst handicap, however, is the dry climate; this enforces the use of surface air, which in all seasons of the year abstracts moisture from the mine workings. This makes the coal-dust the more inflammable and robs Utah coal mines of the definite advantage obtained in other localities where "sweating" takes place during several months of the year and tends to make the mine dust noninflammable.

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A study has been made of various conditions and results in connection with safety in Utah's coal mines for the years 1918 to 1929, inclusive. Table 1, following, compiled from United States Bureau of Mines publications, gives interesting data on production and fatalities:

Table 1.- Coal production, men employed, and men killed in Utah mines, 1918-1929

Year	Coal, short tons	Number employed	Fatal accidents	Annual coal production per employee, tons	
				Utah	Bituminous mines of the United States
1918	5,136,825	4,160	19	1,235	942
1919	4,631,323	3,857	27	1,201	749
1920	6,005,199	4,504	35	1,333	889
1921	4,078,784	4,422	15	922	627
1922	4,992,008	4,721	22	1,057	614
1923	4,720,217	4,381	23	1,077	801
1924	4,488,157	4,330	200*	1,037	781
1925	4,690,342	4,441	24	1,056	884
1926	4,373,793	3,545	21	1,234	966
1927	4,781,480	3,339	26	1,432	872
1928	4,842,544	3,352	18	1,445	959
1929	5,072,527	3,458	34	1,492	1,064

* Castlegate disaster caused 171 deaths.

COAL PRODUCTION AND FATALITIES

The number of mines producing coal in Utah has varied only slightly from 32 in 1918 to 42 in 1929. Many of these are small wagon mines serving communities which are considerable distances from railroads. Most of the coal produced in Utah comes from mines operated by a few relatively large companies. Producers mining in excess of 10,000 tons per year have steadily grown from 13 in 1918 to 22 in 1929. Of these, 8 produced in excess of 100,000 tons in 1918, whereas in 1929, 14 produced in excess of 100,000 tons.

The number of men employed in the mining of coal in Utah has varied somewhat with the production.

The fatal accidents occurring in the coal mines of Utah during the period 1918 to 1929 have totaled 464; the yearly average for the 12 years is 38.66 fatalities; if the major disasters of 1924 at Castlegate with 171 deaths and at Rains with 5 are excluded, the yearly average is 24 fatalities.

The production of coal per man employed in Utah is comparatively high, and for the years studied, has been equalled by other States only on four occasions. During 1918, Wyoming exceeded the production record per employee of Utah by 14 tons. In 1925, both Montana and West Virginia recorded an employee-production figure greater than Utah, respectively, by 80 tons and 55 tons. Again in 1928, Montana exceeded Utah by 72 tons. Table 2 lists the fatal accidents during the period 1918-1929 by causes.

During the 12-year period the greatest number of deaths, 182, or 39.2 per cent, were due to the explosion of gas or coal-dust. As the Castlegate disaster in 1924 accounted for 171 fatalities, the excessive number of deaths due to this cause can not be taken as an index of normal fatalities from gas and coal-dust explosions in Utah, though natural conditions in Utah's coal mines are so extremely dangerous that widespread disasters similar to that at Castlegate in 1924 are likely to occur at any time upon relaxation of safety precautions.

Falls of coal or rock was the cause of the next largest number of fatalities, 163, or 35.1 per cent. Death from falls of coal or rock, although varying in numbers year by year, was the principal cause of fatalities in each of the 12 years, except in 1924, the year of the Castlegate and Rains disasters. Had proper supervision been exercised, adequate timber provided and required to be set in place, and chance-taking penalized, many of these deaths might have been avoided.

Deaths from mine cars and locomotives for the period were 61, or 13.1 per cent of the total; the regularity of their occurrence year after year indicates a failure to apply any effective effort to correct the conditions causing them. However, haulage conditions are such that unless definite precautionary measures are at all times kept in effect against haulage accidents, there are likely to be numerous mishaps and they are likely to be severe.

Table 2. - Fatal accidents in the coal mines of Utah by causes, 1918-1929

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Total
Underground:													
Falls of coal or rock	7	15	18	5	11	11	12	16	15	18	11	24	163
Mine cars and locomotives	4	4	10	5	6	6	7	4	4	3	3	5	61
Explosions of gas or coal-dust	-	1	-	-	-	2	178	-	-	-	-	1	182
Explosives	1	1	-	-	2	1	-	-	-	1	-	-	6
Suffocation from mine gases	-	-	1	-	-	-	1	-	-	-	-	-	2
Electricity	-	-	-	1	1	-	-	1	1	1	-	1	6
Animals	-	-	-	-	-	1	-	-	-	-	-	-	1
Mining machines	1	3	1	2	-	-	-	-	-	-	1	-	8
Other causes	1	-	-	-	-	-	-	-	1	-	1	1	4
Total underground	14	24	30	13	20	21	198	21	21	23	16	32	433
Surface:													
Mine cars and locomotives.	1	1	1	-	1	-	2	-	-	-	2	-	8
Electricity	1	-	3	1	1	-	-	-	-	-	-	1	7
Railway cars and locomotives	2	1	-	1	-	-	-	-	-	-	-	-	4
Other causes	1	1	1	-	-	2	-	3	-	3	-	1	12
Total surface	5	3	5	2	2	2	2	3	-	3	2	2	31
Grand total	19	27	35	15	22	23	200	24	21	26	18	34	464

COMPARISON OF UTAH'S FATALITY RATES WITH THOSE OF THE BITUMINOUS MINES OF THE UNITED STATES

The fatality rate for the coal mines of Utah as compared with all the bituminous mines of the United States, both on the basis of number of employees working and the tonnage produced, can hardly be considered favorable, as may be seen from Table 3.

Table 3. - Fatal accidents in the coal mines of Utah compared with all bituminous mines in the United States, 1918 - 1929

Year	Fatality rate per thousand 300-day workers		Fatality rate per million tons mined		Coal produced per fatality, tons	
	Utah	United States	Utah	United States	Utah	United States
1918	5.28	3.97	3.70	3.50	270,360	285,552
1919	8.77	4.16	5.83	3.62	171,530	275,983
1920	9.26	3.79	5.83	3.13	171,577	319,296
1921	6.73	4.38	3.68	3.48	271,919	287,239
1922	6.86	5.16	4.41	3.99	226,909	250,753
1923	9.88	4.65	4.87	3.46	205,227	289,076
1924	75.81	5.39	44.34	3.94	22,554	253,770
1925	9.05	4.79	5.12	3.53	195,431	283,562
1926	9.12	4.86	4.57	3.60	218,690	277,660
1927	11.16	4.60	5.44	3.36	183,903	297,224
1928	8.44	4.90	3.72	3.45	254,870	289,447
1929	14.01	4.63	6.59	3.19	149,191	312,964
Average	14.18	4.56	7.98	3.51	124,736	285,001

COMPARISON OF FATALITY RATES FOR INDIVIDUAL STATES WITH RATES FOR THE UNITED STATES

The fatality rates for the coal mines of the United States and also comparative figures for each State are shown in Tables 4, 5, and 6 covering 5-year periods, 1919 to 1923, 1920 to 1924, and 1925 to 1929. The figures are shown separately for each of the main causes of fatal accidents—namely, falls of roof and coal, haulage, gas and dust explosions, and miscellaneous. The fatality rates from each of these causes as shown for the United States represents the number of deaths from that cause for each million man-hours of exposure of all underground employees. The figures for the several States indicate the percentage which the State rates bear to the corresponding rate for the United States. The States are listed in the order of their standing as compared with the fatality rates for the United States, and have been reproduced from United States Bureau of Mines Bulletin 283, "Coal-mine accidents in the United States, 1926"; and Bulletin 341, "Coal-mine Accidents in the United States, 1929" by W. W. Adams, published in 1927 and 1931, respectively.

The index tabulation (Table 4) covering the 5-year period 1919 to 1923, inclusive, hence before the Castlegate and Rains disasters, shows that Utah had 2.2 as many fatalities on an exposure basis from falls of roof and coal as the average for the coal mines of the United States, and had by far the worst record of the coal-mining States in fatality rate from falls of roof and coal. Utah had also much the poorest record of the coal-mining States in fatality rate from haulage its rate being 2.81 times that of the industry throughout the United States. For the 5-year period 1919-1923, Utah's fatality rate from mine explosions was good, being less than half of the mine-explosion fatality rate for the whole country. For this 5-year period before the Rains and Castlegate disasters occurred, Utah's coal mines had just double the total underground fatality rate for the industry throughout the country, and only Wyoming and New Mexico had poorer rates.

The tabulation (Table 5) for the exposure fatality rates of the various coal-producing States for the 5-year period 1920-1924 shows Utah's coal mines in a decidedly dark light, because for this period it has the worst rate of all the States from falls of roof and coal, from haulage, from gas or dust explosions, and from all underground fatalities; this dark record for the period 1920-1924 is due in part to the Castlegate and Rains disasters in 1924; but these disasters can not be held responsible for the fact that from 1920 to 1924, inclusive, the exposure fatality rate of Utah's coal mines was 2.19 times that of the mines of the whole country from falls of roof and coal and 2.96 times that from haulage.

And the index tabulation (Table 6) for the 5-year period 1925 to 1929, inclusive, which does not include the deaths from the Castlegate and Rains disasters, again shows Utah's coal mines in a bad light, indicating that as yet Safety in Utah's coal mines has not been brought much if any nearer to the average of the safety of the coal mines of the United States.

COMPENSATION AND MEDICAL COST OF ACCIDENTS IN UTAH

The cost of accidents in the mining of coal in Utah, whether considered on the basis of compensation premiums paid or of the compensation and medical costs awarded, has been no small item in contributing to the expense of production. As costs of coal-mine accidents are available only by fiscal years, the following tabulations (Tables 7, 8, 9, 10, 11) for the fiscal years 1918-1919 to 1928-1929, taken from the reports of the Industrial Commission of Utah, give details relative to the several types of accidents, their rates per 1,000 employees, and the actual costs resulting from them.

Table 4.—*Index numbers, comparing coal-mine fatality rates per million man-hours, underground, for different States, with the average rate for the United States, 1919 to 1923 (revised)*

Falls of roof and coal		Haulage (underground)		Gas and dust explosions		Miscellaneous (underground)		Total underground (including shaft)	
State	Index number	State	Index number	State	Index number	State	Index number	State	Index number
Alaska, California, Idaho, Nevada, and Oregon	......	Arkansas	......	Virginia	......	Alaska, California, Idaho, Nevada, and Oregon	......	South Dakota	......
South Dakota	......	Alaska, California, Idaho, Nevada, and Oregon	......	Maryland	......	Georgia and North Carolina	......	Alaska, California, Idaho, Nevada, and Oregon	26
Texas	13	Georgia and North Carolina	......	Texas	......	South Dakota	......	Georgia and North Carolina	31
Georgia and North Carolina	60	South Dakota	......	Michigan	......	Maryland	22	Texas	32
Michigan	61	Missouri	18	Georgia and North Carolina	......	Tennessee	43	Maryland	54
North Dakota	65	Kansas	22	South Dakota	......	Iowa	59	Missouri	59
Illinois	77	Maryland	22	Missouri	10	Pennsylvania (bituminous)	57	Michigan	61
Pennsylvania (bituminous)	82	Texas	26	Iowa	11	Missouri	60	Iowa	66
Missouri	83	Iowa	39	Ohio	14	Virginia	69	Pennsylvania (bituminous)	73
Indiana	84	Pennsylvania (bituminous)	76	Montana	18	Illinois	71	Tennessee	74
Oklahoma	86	Pennsylvania (anthracite)	85	Tennessee	25	Michigan	71	Illinois	81
Maryland	[illegible]	Oklahoma	87	Utah	49	Kansas	86	Virginia	83
Pennsylvania (anthracite)	[illegible]	Michigan	87	Pennsylvania (bituminous)	51	Alabama	87	Kansas	90
Iowa	90	Virginia	88	West Virginia	54	West Virginia	96	North Dakota	95
Tennessee	91	Tennessee	89	Kentucky	63	Kentucky	96	Kentucky	97
Kansas	93	Alabama	99	Illinois	64	**United States (0.364)**	100	**United States (2.011)**	100
Alabama	96	**United States (0.370)**	100	Pennsylvania (anthracite)	79	Ohio	106	Pennsylvania (anthracite)	101
Kentucky	99	Ohio	100	Washington	86	Texas	113	Indiana	108
Washington	99	Indiana	109	**United States (0.228)**	100	Colorado	116	Ohio	111
United States (1.049)	100	Kentucky	110	North Dakota	120	Wyoming	116	Montana	119
Virginia	104	North Dakota	111	Indiana	153	Oklahoma	133	Washington	121
Montana	133	Illinois	112	Kansas	192	New Mexico	137	Alabama	124
Ohio	138	Washington	123	Alaska, California, Idaho, Nevada, and Oregon	225	Montana	139	West Virginia	135
Arkansas	148	Montana	125	Arkansas	255	Indiana	149	Oklahoma	140
West Virginia	154	Wyoming	152	Alabama	352	North Dakota	150	Arkansas	142
Wyoming	178	New Mexico	153	Colorado	354	Utah	153	Colorado	191
Colorado	186	West Virginia	170	Okalhoma	486	Pennsylvania (anthracite)	163	Utah	200
New Mexico	197	Colorado	178	Wyoming	904	Arkansas	196	Wyoming	244
Utah	220	Utah	281	New Mexico	1,931	Washington	206	New Mexico	375

Table 5.—*Index numbers, comparing coal-mine fatality rates per million man-hours, underground, for different States, with the average rate for the United States, 1920 to 1924 (revised)*

Falls of roof and coal		Haulage (underground)		Gas or dust explosions		Miscellaneous (underground)		Total underground (including shaft)	
State	Index number	State	Index number	State	Index number	State	Index number	State	Index number
Alaska, California, Idaho, Nevada, and Oregon	......	Arkansas	......	Virginia	......	Alaska, California, Idaho, Nevada, and Oregon	......	South Dakota	......
South Dakota	......	Alaska, California, Idaho, Nevada, and Oregon	......	Missouri	......	Georgia and North Carolina	......	Alaska, California, Idaho, Nevada, and Oregon	26
Texas	15	Georgia and North Carolina	......	Maryland	......	South Dakota	......	Texas	29
Michigan	58	South Dakota	......	Montana	......	Maryland	25	Georgia and North Carolina	59
North Dakota	66	Missouri	20	Texas	......	Iowa	54	Missouri	60
Illinois	75	Kansas	24	Michigan	......	Missouri	58	Michigan	62
Tennessee	77	Texas	29	Georgia and North Carolina	......	Kansas	59	Iowa	64
Oklahoma	78	Maryland	35	South Dakota	......	Pennsylvania (bituminous)	62	Maryland	65
Pennsylvania (bituminous)	81	Iowa	40	Iowa	4	Illinois	73	Pennsylvania (bituminous)	73
Indiana	83	Pennsylvania (bituminous)	76	Ohio	8	Virginia	77	Tennessee	74
Kansas	85	North Dakota	76	Tennessee	36	Tennessee	82	Kansas	77
Pennsylvania (anthracite)	86	Pennsylvania (anthracite)	79	Kentucky	50	Ohio	88	Illinois	80
Missouri	91	Oklahoma	79	Pennsylvania (bituminous)	51	Texas	95	Virginia	85
Iowa	93	Virginia	80	Pennsylvania (anthracite)	62	Michigan	99	North Dakota	88
Alabama	95	Tennessee	88	Illinois	66	**United States (0.338)**	100	Pennsylvania (anthracite)	91
United States (1.047)	100	Alabama	90	Indiana	93	Alabama	102	Indiana	99
Maryland	107	Michigan	92	North Dakota	94	Kentucky	106	**United States (2.049)**	100
Kentucky	112	**United States (0.367)**	100	**United States (0.297)**	100	West Virginia	107	Kentucky	102
Virginia	113	Ohio	103	West Virginia	118	Wyoming	110	Ohio	105
Georgia and North Carolina	115	Indiana	103	Kansas	134	Colorado	112	Alabama	115
Washington	130	Illinois	111	Washington	149	Utah	144	Oklahoma	125
Ohio	139	Kentucky	114	Colorado	158	Pennsylvania (anthracite)	145	Montana	136
Arkansas	148	Washington	121	Alaska, California, Idaho, Nevada, and Oregon	180	Indiana	149	Washington	143
West Virginia	155	New Mexico	132	Arkansas	204	Montana	159	Arkansas	145
Montana	167	Montana	135	Alabama	232	New Mexico	164	West Virginia	146
Colorado	172	Wyoming	169	Oklahoma	275	North Dakota	165	Colorado	163
Wyoming	186	West Virginia	182	Wyoming	968	Oklahoma	187	Wyoming	284
New Mexico	198	Colorado	187	New Mexico	1,537	Washington	202	New Mexico	375
Utah	219	Utah	296	Utah	2,273	Arkansas	239	Utah	518

TABLE 6.—*Index numbers, comparing coal-mine fatality rates per million man-hours, underground, for different States, with the average rate for the United States, 1925 to 1929*

Falls of roof and coal		Haulage (underground)		Gas or dust explosions		Miscellaneous (underground)		Total underground (including shaft)	
State	Index No.	State	Index No.	State	Index No.	State	Index No.	State	Index No.
eorgia and North Carolina		Alaska, California, Idaho, Nevada, Arizona, and Oregon		Missouri		South Dakota		South Dakota	
outh Dakota		South Dakota		Maryland		Maryland	34	Texas	45
ichigan	53	Texas	23	New Mexico		Pennsylvania (bituminous)	56	Maryland	57
exas	54	Kansas	30	Montana		Virginia	68	Michigan	61
aryland	64	Missouri	44	Texas		Wyoming	70	Missouri	68
orth Dakota	69	Iowa	57	Michigan		Illinois	74	Illinois	73
linois	71	Pennsylvania (anthracite)	68	North Dakota		Kentucky	75	Kansas	73
issouri	71	Tennessee	68	Alaska, California, Idaho, Nevada, Arizona, and Oregon		New Mexico	75	Alaska, California, Idaho, Nevada, Arizona, and Oregon	77
laska, California, Idaho, Nevada, Arizona, and Oregon	73	Pennsylvania (bituminous)	78	South Dakota		Tennessee	77	North Dakota	80
ansas	74	Oklahoma	78	Ohio	6	Texas	84	Pennsylvania (bituminous)	81
labama	80	Illinois	88	Virginia	12	Iowa	95	Pennsylvania (anthracite)	91
ndiana	82	Ohio	89	Utah	14	Utah	96	Kentucky	92
ennsylvania (bituminous)	83	Indiana	91	Iowa	25	Michigan	96	Tennessee	98
ennessee	85	United States (0.379)	100	Wyoming	35	United States (0.312)	100	Ohio	99
ennsylvania (anthracite)	92	Maryland	104	Illinois	59	West Virginia	101	United States (2.125)	100
owa	92	Kentucky	106	Pennsylvania (anthracite)	62	Alabama	120	Virginia	101
klahoma	92	Arkansas	106	Kentucky	62	Ohio	129	Alabama	103
United States (1.122)	100	Michigan	106	Kansas	64	Indiana	129	Montana	103
entucky	101	Virginia	107	Colorado	70	Kansas	129	Indiana	123
rkansas	103	Alabama	109	West Virginia	96	Colorado	136	Iowa	123
ontana	107	North Dakota	122	Washington	98	Pennsylvania (anthracite)	144	West Virginia	128
hio	119	Montana	130	United States (0.312)	100	North Dakota	148	New Mexico	131
est Virginia	131	Colorado	134	Pennsylvania (bituminous)	105	Missouri	150	Colorado	136
irginia	133	Washington	151	Alabama	163	Montana	158	Wyoming	136
olorado	155	Wyoming	159	Tennessee	206	Arkansas	240	Washington	174
ashington	157	West Virginia	165	Indiana	303	Oklahoma	246	Arkansas	174
ew Mexico	161	Utah	170	Arkansas	443	Alaska, California, Idaho, Nevado, Arizona, and Oregon	263	Utah	227
yoming	174	New Mexico	197	Oklahoma	1,864	Washington	338	Oklahoma	372
tah	341	Georgia and North Carolina	986	Georgia and North Carolina	10,978	Georgia and North Carolina	599	Georgia and North Carolina	1,876

Table 7. - Fatal accidents in the coal mines of Utah for the fiscal years 1918-1919 to 1928-1929

Fiscal year	Fatal accidents	Rates per 1,000 employees	Compensation and medical costs
1918-1919	24	6.8	$ 51,304
1919-1920	30	6.9	58,810
1920-1921	31	6.3	72,394
1921-1922	19	3.9	56,816
1922-1923	24	4.7	67,934
1923-1924	190	35.4	688,849
1924-1925	33	7.0	146,659
1925-1926	19	3.9	71,823
1926-1927	28	7.3	101,096
1927-1928	17	4.4	57,788
1928-1929	25	5.9	99,894
Total	440	8.9	$1,473,367
Average per year.	40	8.9	$ 133,942

Table 8. - Accidents causing permanent total disabilities in the coal mines of Utah for the fiscal years 1918-1919 to 1928-1929

Fiscal year	Permanent total disabilities	Rate per 1,000 employees	Compensation and medical costs
1918-1919	-	-	-
1919-1920	-	-	-
1920-1921	2	0.4	$ 24,000
1921-1922	-	-	-
1922-1923	-	-	-
1923-1924	-	-	-
1924-1925	-	-	-
1925-1926	-	-	-
1926-1927	-	-	-
1927-1928	3	0.7	$ 45,000
1928-1929	-	-	-
Total	5	0.1	$ 69,000
Average per year.	0.4	0.09	$ 6,273

Table 9. - Accidents causing permanent partial disabilities in the coal mines of Utah for the fiscal years 1918-1919 to 1928-1929

Fiscal year	Permanent partial disabilities	Rate per 1,000 employees	Compensation and medical costs
1918-1919	19	5.4	$ 21,661
1919-1920	16	3.7	16,616
1920-1921	29	5.9	46,572
1921-1922	23	4.8	17,845
1922-1923	26	5.1	21,512
1923-1924	19	3.5	15,182
1924-1925	35	7.4	40,044
1925-1926	25	5.2	20,098
1926-1927	62	16.3	85,240
1927-1928	50	13.0	53,859
1928-1929	89	21.1	123,859
Total	393	7.9	$ 462,488
Average per year.	35.7	7.9	$ 42,044

Table 10. - Accidents causing temporary injuries in the coal mines of Utah for the fiscal years 1918-1919 to 1928-1929

Fiscal year	Temporary injuries	Rate per 1,000 employees	Compensation and medical costs
1918-1919	1,599	458.6	$ 41,591
1919-1920	2,134	493.9	64,295
1920-1921	2,075	427.6	66,209
1921-1922	1,770	369.5	78,122
1922-1923	1,611	320.8	60,722
1923-1924	1,714	320.1	60,938
1924-1925	1,722	365.8	66,165
1925-1926	1,698	353.8	63,170
1926-1927	1,637	431.6	46,309
1927-1928	1,645	429.7	45,250
1928-1929	1,887	448.5	52,264
Total	19,492	396.5	$ 645,035
Average per year	1,772	396.5	$ 58,640

Table 11. - Total compensible injuries in the coal mines of Utah for the fiscal years 1918-1919 to 1928-1929

Fiscal year	All compensible injuries	Rate per 1,000 employees	Compensation and medical costs
1918-1919	1,642	471.0	$ 114,556
1919-1920	2,180	504.6	139,721
1920-1921	2,137	440.4	209,174
1921-1922	1,812	378.2	152,783
1922-1923	1,661	330.8	150,168
1923-1924	1,923	359.2	764,969
1924-1925	1,790	380.2	252,868
1925-1926	1,742	363.0	155,091
1926-1927	1,727	455.4	232,645
1927-1928	1,715	448.0	201,897
1928-1929	2,001	475.6	276,017
Total	20,330	413.5	$2,649,889
Average per year.	1,848.1	413.5	$ 240,899

The fatal accidents which occurred in the coal mines of Utah for the 11-year period totaled 440, or an average of 40 per year. The fatal accident rates show no marked fluctuation except for the fiscal year 1923-1924 when the Castlegate disaster occurred.

Compared with similar fatal accident rates for all bituminous mines of the United States, the Utah rates are year by year consistently higher, and for most years more than double. For the entire period the fatal accident rate for the coal mines of Utah per 1,000 employees is 8.9 compared with a rate of 2.9 per 1,000 employees for all the bituminous coal mines of the United States for the same period.

There have been few permanent total disabilities in the coal mines of Utah; only 5 cases were recorded in the 11 years.

Permanent partial disabilities during the period totaled 393, giving a yearly average of 35.7 and a yearly rate per 1,000 employees of 7.9. During the last three fiscal years studied there was a marked rise in injuries resulting in permanent partial disabilities, the rates per 1,000 employees increasing from 5.2 in 1925-1926 to 16.3 in 1926-1927, 13.0 in 1927-1928, and 21.1 in 1928-1929, or more than 400 per cent increase in 1928-1929 as compared with 1925-1926. There is good reason to believe that much, if not all of this increase, is due to mechanized loading and other mechanization of mining, which were being rapidly expanded in Utah's coal mines during these three years.

The total temporary injuries for the 11 years amounted to 19,492, with a yearly average of 1,772 and a yearly rate per 1,000 employees of 396.5. The rates per 1,000 employees for temporary disabilities also increased from 353.8 in 1925-1926 to 431.6 in 1926-1927, 429.7 in 1927-1928, and 448.5 in 1928-1929, or 26 per cent increase in 1928-1929 as compared with 1925-1926. Here again mechanization undoubtedly contributed largely, if not wholly, to the increased injury rate.

Judging from the accident experience shown in the foregoing tabulations for the 11 fiscal years, one can view the mining of coal in Utah only as a very hazardous occupation. The rates indicate that for every thousand men employed, at least 413, or 41.3 per cent, receive a disabling injury each year. Of these 413 injuries about 9 result fatally, about 8 are permanent partial disabilities to be carried through life, and the remaining 396 are temporary disabilities with loss of 4 to 28 or more days.

RELATION OF ACCIDENT CHARGES TO MINING COSTS

The economic relation of accidents to coal-mining costs in Utah is becoming more and more apparent. With the decreasing value of coal at the mines and the increasing cost of compensation insurance, due chiefly to greater numbers of accidents, the small margin of possible profit in coal mining is being definitely decreased in most cases, and in some instances the possible profit is actually turned into a loss by the cost of accidents. Should the tendency to yearly increase of coal-mining accidents continue, the resultant rates for compensation insurance will necessarily increase, possibly to such an extent that they are liable to reduce returns on coal mining to a point where little or no profit may be shown.

During the 11 fiscal years included in this study the compensation and medical costs of accidents have been as follows:

Fatal accidents	$1,473,367
Permanent total disabilities	69,000
Permanent partial disabilities	462,487
Temporary disabilities	645,035
Total	$2,649,889

The yearly average of these costs amounting to $240,899, nearly one-quarter of a million dollars, is most certainly an unduly large sum to be expended for accidents in the mining of an average of 4,794,606 tons of coal per year.

Although the foregoing figures represent the medical costs and compensation awards made as the result of accidents in the coal mines of Utah, they fall far short of the real cost of those accidents. The compensation insurance paid as coverage for accident liability represents more nearly the true costs, as it is the actual direct outlay.

During the 11 years the compensation premiums paid by Utah's coal mines have amounted to $4,125,381, or an average of $375,035 yearly. For the full 11-year period the compensation premium cost has averaged 7.8 cents per ton of coal mined, or 2.8 per cent of the average value of the coal over the tipple.

The compensation rates during the early part of the period were found to be high, $7.81 per $100 of the payroll. In 1920 they were reduced to $5.34 for the stock companies and $4.28 for the State Insurance Fund and self-insurers. A further reduction was made in 1922 to $3.90 for the stock companies and $3.12 for the State and self-insurers. These rates prevailed until 1928 when, due to the increased number of accidents and their resultant medical and compensation costs, an increase in premium rates became necessary. The rates were increased from $3.90 to $5 for stock companies, and from $3.12 to $4.25 for the State and self-insurers. Reflecting this increase, the total premiums for the fiscal year 1927-1928 of $251,505 jumped to $335,830 for the fiscal year 1928-1929. Even this increase was not sufficient to cover the mounting costs of the greater number of accidents; so on January 1, 1930, the rates were again raised to $7 for stock companies and $5.95 for the State and self-insurers. Thus, in less than two years it has been found necessary to increase the compensation insurance rates approximately 80 per cent, and in this it may be well to remember that much, if not all, of the increase in the accident rate was due to the extension of mechanization in Utah's coal mines. Should accidents continue to increase in the same proportion as they have in the last four fiscal years, a further raise in the compensation premium rates is inevitable.

A review of the official reports of fatal accidents occurring in the coal mines of Utah shows conclusively that many of them could have been avoided. Likewise, the low accident records not only of certain of the coal mines of Utah, but of other large coal-mining companies throughout the United States with hazards fully as great as those common to Utah mines, give ample evidence that coal can be mined in Utah as well as elsewhere with low accident rates. Further, it is believed that should, say, 20 per cent of the present yearly cost of $375,000 for compensation insurance be expended for increased inspection and supervisory forces, closer supervision of working places, increased timber supplies, the installation and use of a safer type of equipment, the instruction and disciplining of employees, and a conscientious and continued effort put forth by the managers, supervisors, and working force, the accident rates of the coal mines of Utah can be reduced so that the compensation premium rates may be lowered to a point where the savings will be several times the money expended in those efforts.

Table 12 summarizes the fatal accidents by company and year.

DISCUSSION OF DATA PRESENTED

Falls

The Kinney Coal during its operating life, 1919-1925 had the unique record of not having a fatality from falls of coal or rock; however, this mine did have two fatalities, one from a mining machine in the underground working and one on the surface. The Chesterfield Coal Co. and its predecessor, the American Fuel Co. had no fatalities from falls of coal or rock during the period 1918-1929, and the Weber Coal Co. had but one fatality from falls of coal or rock during the period 1918-1929, inclusive.

Table 12. - Fatal accidents in the coal mines of Utah by producing companies, 1913-1929

Name	1928	1929	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Total
Blue Blaze Coal Co.[1]	-	-	-	-	-	-	-	-	1	-	1	-	2
Carbon Fuel Co.	-	2	1	-	2	1	5	1	1	-	-	-	13
Chesterfield Coal Co.[2]	1	-	2	-	1	-	-	-	-	-	1	1	6
Columbia Steel Corp.[3]	-	-	-	-	-	-	2	-	-	-	-	1	3
Grass Creek Fuel Co.	-	-	-	-	-	-	-	2	-	-	-	-	2
Independent Coal and Coke Co.	-	3	-	3	-	1	2	1	1	1	3	4	19
Kinney Coal Co.[4]	-	-	1	1	-	-	-	-	-	-	-	-	2
Liberty Fuel Co.	1	-	3	-	1	-	-	2	-	2	-	-	9
Lion Coal Co.	1	1	-	-	-	2	3	1	1	1	-	-	10
MacLean Coal Co.[5]	-	-	-	-	-	-	1	-	-	-	-	-	1
Milburn Mine Co.	1	-	-	-	-	-	-	-	-	-	-	-	1
Mutual Coal Co.[6]	-	-	-	1	1	2	-	2	1	3	1	-	11
National Coal Co.[7]	-	-	-	-	-	-	-	-	-	-	-	1	1
Pack and Allen Coal Co.[8]	-	-	-	-	-	-	-	1	-	-	-	-	1
Peerless Coal Co.	-	-	1	-	-	-	-	-	1	1	1	1	5
Royal Coal Co.[9]	-	-	1	-	-	1	2	-	-	1	-	-	5
Scofield Coal Co.	2	-	-	-	1	-	-	1	-	-	-	-	4
Spring Canyon Coal Co.	3	2	-	2	1	4	3	3	5	3	3	6	35
Standard Coal Co.	3	1	2	1	3	4	3	2	1	1	3	4	28
Sweet Coal Co.[10]	-	-	-	-	-	-	-	-	-	1	-	1	2
U. S. Fuel Co.	2	4	13	1	4	3	3	4	4	2	3	7	50
Utah Fuel Co.	5	14	10	6	8	5	176	4	5	10	2	7	252
Weber Coal Co.	-	-	1	-	-	-	-	-	-	-	-	1	2
Total	19	27	35	15	22	23	200	24	21	26	18	34	464

1 - Consumers Mutual Coal Co. prior to 1927. Commercial production since 1926. 2 - American Fuel Co. prior to 1923. 3 - Commercial production since 1923. 4 - Ceased production in 1925. 5 - Commercial production since 1923. 6 - Commercial production since 1921. 7 - Commercial production since 1923. 8 - Wagon mine. 9 - Cameron Coal Co. prior to 1924. 10 - Commercial production since 1927.

Haulage

Companies which had no fatalities from mine cars or locomotives underground are the Grass Creek Fuel Co. during the period 1918-1929, inclusive, the Kinney Coal Co. through its entire existence, 1919-1925, inclusive, the MacLean Coal Co. from 1923-1929, inclusive, the National Coal Co. in the two years 1928 and 1929, the Peerless Coal Co. from 1918 to 1929, inclusive, the Sweet Coal Co. 1927-1929, inclusive, and the Weber Coal Co. 1918 to 1929, inclusive.

Explosions

During the period 1918 to 1929, inclusive, mines had explosions of gas or dust as follows: Carbon Fuel Co. in 1929 with one death and in 1924 with five fatalities; Spring Canyon Coal Co. in 1924 with two fatalities and in 1929 with one death; the Standard Coal Co. in 1923 with two fatalities; and the Utah Fuel Co. in 1924 with 171 fatalities.

After the Winter Quarters disaster of May 1, 1900, with its 200 fatalities, very rigid precautionary measures were adopted and kept in effect, in consequence of which nearly 24 years elapsed before the occurrence of another major disaster; however, as early as 1915 or 1916 there were numerous relaxations in the precautionary methods and practices, and the failure to have had disasters long before those of 1924 at Castlegate and at Rains can be considered as merely fortunate. In a similar manner, several years have now elapsed since the Castlegate and Rains disasters, and there is no question that many unsafe practices and methods are in effect in Utah's coal mines; in particular, much unsafe electrical equipment is being placed at gassy and dusty faces, the inevitable result of which will unquestionably be the occurrence of explosions and fires unless drastic steps are taken towards enforcing adequate safeguarding measures.

Explosives

The companies that had fatalities from explosives were The Independent Coal & Coke Co. in 1927, one death; the Liberty Fuel Co. in 1918, one fatality; the Spring Canyon Coal Co. in 1923, one death; the Standard Coal Co. in 1919, one fatality, and the Utah Fuel Co. in 1922, two fatalities. The record of the United States Fuel Co. with five large mines producing during much of the period 1918 to 1929, and with no fatalities from explosives, is a definite indication of the safety of the blasting system used exclusively by this company; all shots are fired electrically from the surface when all persons, including the shotfirer, are out of the mine. This system is also used by the mine of the Columbia Steel Corporation which has had no fatalities from blasting during its existence from 1923 to 1929, and by the Peerless Coal Co. and the Royal Coal Co., both of which operated from 1918 to 1929 without a fatality from blasting.

Electricity

Fatalities from electricity occurred as follows: Carbon Fuel Co. in

1920, one death on the surface; Chesterfield Coal Co., one death in 1922 on the surface; the Independent Coal & Coke Co. in 1929, one death on the surface; the Liberty Fuel Co. in 1920, one death on the surface; the Mutual Coal Co., one death underground in each of the years 1922, 1925, and 1926; the Royal Fuel Co., one death underground in 1927; the Spring Canyon Coal Co., one death on the surface in 1921 and one underground in 1929; the United States Fuel Co., one death on the surface in 1918; the Utah Fuel Co., one death underground in 1921, and the Weber Coal Co., one on the surface in 1920. Of the 13 deaths from electricity at Utah's coal mines during the period 1918 to 1929, seven were on the surface, indicating laxity in surface electrical installations. Ten of the 23 coal-mining companies of Utah had fatalities from electricity during the period 1918 to 1929.

Mining Machines

Mining machines caused the only underground fatality in the career of the Kinney Coal Co.; this death occurred in 1921, and the mine was closed in 1925. Other fatal accidents from mining machines were one in 1918 in a mine of the Spring Canyon Coal Co.; one in 1928 in a mine of the Standard Coal Co.; one in 1919 and one in 1920 in mines of the United States Fuel Co.; and two in 1919 and one in 1921 in mines of the Utah Fuel Co.--a total of eight for the period under review. Most of these accidents could have been avoided by adequate guarding and more careful use of mining machines; the latter for instance, the practice of leaving but one man on a coal-cutting mining machine, in vogue in some of Utah's coal mines, is so manifestly dangerous that it should not be allowed. Accidents of all classes caused by various types of mining machines can be expected to occur and probably with increasing frequency and severity unless the most rigid of precautionary measures are adopted and maintained in the mechanization of underground loading and other processes now being extensively introduced into the coal mines of Utah, as well as of other States.

Surface Fatalities

On the surface, mine cars and locomotives caused deaths as follows: The Chesterfield Coal Co., one in 1918; Lion Coal Co., two in 1924; Peerless Coal Co., one in 1928; Spring Canyon Coal Co., one in 1919; and the Standard Coal Co., one each in 1920, 1922, 1928, and 1929; a total of nine. Inasmuch as most of these fatalities were in connection with walking on surface inclines, it would appear advisable, if practicable, to make adequate provision for safe travel ways for men rather than to allow them to travel on or alongside of these haulage tracks on inclines. These surface inclines also have a definite hazard in the man-trips which consist merely of empty cars, and essentially without taking any precautions other than would be taken with the same number of cars loaded with coal; it would appear advisable to have specially constructed man cars or man trips with all available safeguards and precautions; if this is not done, major disasters are likely to occur in connection with man trips on those inclines. As previously indicated, seven persons were killed on the surface by electricity, as well as six others in underground workings, indicating laxity in both the installation and use of electricity in and around Utah coal mines.

Mining companies with no surface fatalities during the period of this study are the Blue Blaze Coal Co., Columbia Steel Corporation, Grass Creek Coal Co., MacLean Coal Co., Mutual Coal Co., National Coal Co., Royal Coal Co., and the Sweet Coal Co. Surface accidents at coal mines in Utah, as well as elsewhere, are caused largely by engineering failures or inefficiencies; this is also the case with accidents from mine cars or locomotives, from electricity, from railroad cars and locomotives, and from a number of other sources of accident occurrence on the surface at coal mines. The engineer who neglects safety in the design and operation of surface structures and equipment has done a poor job, unfortunately, safety is often neglected in tipples, mine railroad yards, hoisting or other haulage arrangements, and at other places on the surface.

Table 13 lists the fatality rates per million tons of coal produced for certain Utah companies compared with the rate for all bituminous mines in the United States.

Table 13. - Relative fatality rates per million tons produced in the coal-mining companies of Utah

Period	Name	Company rate	Rate for all coal mines of Utah	Rate for all bituminous mines of the United States
1923 - 1929	Columbia Steel Corporation	1.3	10.4	3.5
1918 - 1929	Royal Coal Co.	2.5	8.0	3.5
1918 - 1929	Peerless Coal Co.	2.9	8.0	3.5
1919 - 1925	Kinney Coal Co.	3.2	10.2	3.5
1926 - 1929	Blue Blaze Coal Co. . . .	3.4	5.1	3.4
1918 - 1929	Independent Coal & Coke Co.	3.6	8.0	3.5
1918 - 1929	United States Fuel Co. . .	4.2	8.0	3.5
1918 - 1929	Liberty Fuel Co.	4.3	8.0	3.5
1918 - 1929	Scofield Coal Co.	4.7	8.0	3.5
1918 - 1929	Chesterfield Coal Co. . .	4.8	8.0	3.5
1918 - 1929	Weber Coal Co.	5.0	8.0	3.5
1918 - 1929	Carbon Fuel Co.	5.9	8.0	3.5
1918 - 1929	Lion Coal Co.	6.2	8.0	3.5
1923 - 1929	MacLean Coal Co.	6.4	10.4	3.5
1927 - 1929	Sweet Coal Co.	6.5	5.2	3.3
1918 - 1929	Standard Coal Co.	6.9	8.0	3.5
1918 - 1929	Spring Canyon Coal Co. . .	7.1	8.0	3.5
1918 - 1929	Grass Creek Fuel Co. . . .	7.4	8.0	3.5
1928 - 1929	National Coal Co.	8.2	5.2	3.3
1921 - 1929	Mutual Coal Co.	8.3	9.0	3.5
1918 - 1929	Utah Fuel Co.	17.8	8.0	3.5

The fatality rates per 1,000,000 tons produced for the coal-mining companies of Utah compared with like rates for all of the bituminous mines of the United States show four companies with better rates than those of the bituminous coal industry as a whole, and one equally as good. The majority of Utah companies present accident rates considerably above those prevailing for the whole country, although the thick beds of coal in Utah and the high tonnage per man employed gives its coal mines a distinct advantage in accident rates on a tonnage basis.

Compared with the rates for all coal mines of the State, only three companies fail to have a better record than the State rates. The State rate, influenced by the Castlegate and Rains disasters for the period including 1924 is abnormally high, as will be seen by comparing rates for periods excluding 1924 where differences of three to five points are shown.

Table 14 lists the coal produced per fatality in certain Utah and in all bituminous mines.

Table 14. - Relative tonnages produced per fatality for the coal mines of Utah

Period	Name	Company tonnage	All coal mines of Utah, tonnage	All bituminous mines of the United States, tonnage
1923 - 1929	Columbia Steel Corporation .	763,380	95,472	285,578
1918 - 1929	Royal Coal Co.	386,850	124,736	285,001
1918 - 1929	Peerless Coal Co.	342,597	124,736	285,001
1919 - 1925	Kinney Coal Co.	306,656	97,127	279,251
1926 - 1929	Blue Blaze Coal Co.	298,905	193,279	293,523
1918 - 1929	Independent Coal & Coke Co.	270,920	124,736	285,001
1918 - 1929	United States Fuel Co. . . .	235,032	124,736	285,001
1918 - 1929	Liberty Fuel Co.	229,720	124,736	285,001
1918 - 1929	Scofield Coal Co.	212,045	124,736	285,001
1918 - 1929	Chesterfield Coal Co. . . .	208,195	124,736	285,001
1918 - 1929	Weber Coal Co.	198,820	124,736	285,001
1918 - 1929	Carbon Fuel Co.	168,867	124,736	285,001
1918 - 1929	Lion Coal Co.	160,699	124,736	285,001
1923 - 1929	MacLean Coal Co.	156,115	95,472	285,578
1927 - 1929	Sweet Coal Co.	152,787	189,242	299,856
1918 - 1929	Standard Coal Co.	144,060	124,736	285,001
1918 - 1929	Spring Canyon Coal Co. . . .	139,830	124,736	285,001
1918 - 1929	Grass Creek Fuel Co.	133,516	124,736	285,001
1928 - 1929	National Coal Co.	121,200	121,902	301,194
1921 - 1929	Mutual Coal Co.	119,101	109,932	282,077
1918 - 1929	Utah Fuel Co.	55,914	124,736	285,001

The tonnage produced per fatality for five of the coal companies of Utah are above the average for all the bituminous mines of the United States, whereas the balance of the companies show tonnages which are far from favorable. Compared with tonnages for all the coal mines of the State, however, only three companies fail to equal the State average. Here again the influence of the disaster of 1924 is apparent in the State tonnages where that year is included in the periods considered.

Table 15 gives the coal mined per employee in certain Utah mines and in all bituminous mines.

Table 15. - Yearly tonnage produced per employee for the coal mines of Utah

Period	Name	Company tonnage	All coal mines of Utah, tonnage	All bituminous mines of United States, tonnage
1923 - 1929	Columbia Steel Corporation .	1,734	1,197	888
1918 - 1929	Independent Coal & Coke Co.	1,393	1,174	832
1918 - 1929	Liberty Fuel Co.	1,389	1,174	832
1918 - 1929	United States Fuel Co. . . .	1,365	1,174	832
1928 - 1929	National Coal Co.	1,247	1,320	978
1927 - 1929	Sweet Coal Co.	1,217	1,354	939
1918 - 1929	Peerless Coal Co.	1,204	1,174	832
1926 - 1929	Blue Blaze Coal Co.	1,139	1,324	946
1918 - 1929	Royal Coal Co.	1,111	1,174	832
1921 - 1929	Mutual Coal Co.	1,100	1,146	822
1918 - 1929	Spring Canyon Coal Co. . . .	1,096	1,174	832
1918 - 1929	Standard Coal Co.	1,086	1,174	832
1918 - 1929	Lion Coal Co.	1,061	1,174	832
1918 - 1929	Carbon Fuel Co.	974	1,174	832
1918 - 1929	Chesterfield Coal Co. . . .	965	1,174	832
1919 - 1925	Kinney Coal Co.	953	1,096	741
1918 - 1929	Utah Fuel Co.	947	1,174	832
1923 - 1929	MacLean Coal Co.	918	1,197	888
1918 - 1929	Scofield Coal Co.	888	1,174	832
1918 - 1929	Weber Coal Co.	746	1,174	832
1918 - 1929	Grass Creek Fuel Co.	745	1,174	832

The tonnages produced per employee by the coal-mining companies of Utah have always been high, and in only three instances of the periods studied has production fallen below the averages for all the bituminous mines of the country. Less than one-half of the companies, though, showed tonnages equal to the averages for Utah.

Table 16 gives the fatality rates per 1,000 employees for certain Utah companies and for all bituminous mines.

Table 16. - Relative fatality rates for thousand employees for the coal mining companies of Utah

Period	Name	Company rate	Rate for all coal mines of Utah	Rate for all bituminous mines of the United States
1923 - 1929	Columbia Steel Corp. . . .	2.2	12.5	3.1
1918 - 1929	Royal Coal Co.	2.8	9.4	2.9
1919 - 1925	Kinney Coal Co.	3.1	16.7	2.6
1918 - 1929	Peerless Coal Co.	3.5	9.4	2.9
1918 - 1929	Weber Coal Co.	3.7	9.4	2.9
1926 - 1929	Blue Blaze Coal Co. . . .	3.9	6.8	3.2
1918 - 1929	Scofield Coal Co.	4.1	9.4	2.9
1918 - 1929	Chesterfield Coal Co. . .	4.6	9.4	2.9
1918 - 1929	Independent Coal & Coke Co.	5.1	9.4	2.9
1918 - 1929	Grass Creek Fuel Co. . . .	5.6	9.4	2.9
1918 - 1929	Carbon Fuel Co.	5.7	9.4	2.9
1923 - 1929	MacLean Coal Co.	5.8	12.5	3.1
1918 - 1929	United States Fuel Co. . .	5.8	9.4	2.9
1918 - 1929	Liberty Fuel Co.	6.0	9.4	2.9
1918 - 1929	Lion Coal Co.	6.6	9.4	2.9
1918 - 1929	Standard Coal Co.	7.5	9.4	2.9
1918 - 1929	Spring Canyon Coal Co. . .	7.8	9.4	2.9
1927 - 1929	Sweet Coal Co.	7.9	7.1	3.1
1921 - 1929	Mutual Coal Co.	9.2	10.4	2.9
1928 - 1929	National Coal Co.	10.3	6.8	3.2
1918 - 1929	Utah Fuel Co.	16.9	9.4	2.9

The fatality rates per 1,000 employees for the coal-mining companies of Utah compared with the same rates for all bituminous mines of the United States for like periods reveal only two Utah coal-mining companies--the Columbia Steel Co. and the Royal Coal Co.--having rates equal to or better than the rate for the United States. These two instances prove, however, that it is possible to mine coal in Utah with as low a fatality rate as elsewhere in the United States, and these mines afford records which the other coal-mining companies can, if they will, duplicate or better.

The records of nearly one-half of the companies show rates more than double those for the bituminous mines of the United States, and with several of the companies the rates are three or four times as high.

The company rates compared with those for all the coal mines of Utah are in most cases low, but this is due wholly to the fact that the years considered in this study include 1924 when the Castlegate and Rains disasters with 177 fatalities occurred, and this gives a State rate decidedly higher than normal.

UTAH COAL-MINING REGULATIONS

Utah's coal-mining regulations are generally held to be the most drastic in the United States, if not in the world, and embody many of the most up-to-date policies for safeguarding mines and employees. These regulations have either been framed by the coal operators or have been adopted only after the written approval of the operators has been received. Not only have the Utah coal operators had a deciding voice in the framing of every State regulation under which they are working, but they may at any time have any State regulations as to individual or unusual conditions suspended or entirely revoked or changed, by presenting to the State Industrial Commission a reasonable showing why such suspension or change should be made.

Utah's original mining law was altered little, if at all, between 1900 and 1917, when the act was passed creating the State Industrial Commission and placing the inspection of coal mines thereunder. In 1918, an agreement was made with the Federal Government, whereby the latter furnished a mining engineer who acted as chief mine inspector representing both the State and the Federal Government. Shortly after this act became effective, a committee of five coal operators and mining engineers, representing the larger as well as smaller producers, together with the chief mine inspector, the State coal-mining inspector, and three electrical engineers, was appointed to frame detailed regulations for Utah's coal mines. Very detailed, and in some respects radical, regulations were adopted and placed in pamphlet form; the regulations became effective on September 1, 1920.

Under these regulations, detailed safety rules were issued regarding most of the operations in a coal mine; some of the outstanding features were the following: Every mine was required to have a checking system which would account for the whereabouts of every man in the mine and especially show when all were out of the mine. All mines, whether gassy or nongassy, were required to have a regular fire boss's inspection before the shift entered the mine. All mines were required to have first-aid supplies and equipment and first-aid stations underground; where more than 50 men were employed underground, the mines were required to have a corps of men trained in first aid and in mine rescue, and to have rescue apparatus available. Travel ways separate from haulage roads were required where the dip of the coal exceeded 10°. Hoisting enginemen were required to have a health certificate. Mining machines must have guards over the bits; numerous provisions were also made as to guarding gears, and other features of the tipple as well as of underground machinery. Sprinkling was required except in places naturally wet or made wet by the use of steam; water hose would be furnished any face worker who requested it. In addition, there were fairly complete provisions as to ventilation, use of electricity, safety lamps, timbering, the use, handling, and storage of explosives, and as to other operations.

After the Federal leasing act became effective in 1921, many of the Utah coal companies took Federal leases, operating the leased land through existing mines, thereby making the Federal leasing regulations applicable to such mines. These Federal regulations are held to be somewhat radical, yet they, as well as Utah's regulations, are now applicable to Utah coal mines producing much of the coal of the State.

The Castlegate explosion in March, 1924, created a feeling that some of the optional or provisional requirements of both the Utah regulations and of the Federal leasing regulations should be made obligatory. Therefore, at the request of the State Industrial Commission of Utah, the Utah Coal Mine Inspection force and some engineers of the United States Bureau of Mines suggested some modifications of the Utah coal-mining regulations which were submitted to a committee of Utah coal operators. This committee, composed of members appointed by each of the 18 main operating coal companies of Utah and representing more than 95 per cent of the total State production, consisted of general managers, general superintendents, chief engineers, and mine superintendents, every one with many years of mining experience and undoubtedly the men best qualified to safeguard the interests of their employers. This committee accepted without change six of the proposed new regulations and accepted the other five after they were somewhat amended. In turn, the State Industrial Commission accepted the findings of the coal operators' committee, including the changes made by the committee. The revised so-called drastic regulations adopted in Utah, in 1924, in this way received the written approval of every large coal-mining company in Utah before they were adopted. Under these new regulations, Utah coal mines were the first in the United States to require rock-dusting and to use rock-dust barriers; to exclude black powder and use nothing but permissible explosives in the shooting of coal; to exclude fuse and squibs and have all blasting done by electricity, (even then no blasting may be done with the shift in the mine); to exclude open lights and allow nothing but permissible closed electric lamps for the miners and permissible magnetically locked flame safety lamps for inspection work, the requirement extending to so-called nongassy as well as to gassy mines; to have water piped to every working face with use of water hose at and around face by miners; to compel all coal cutting to be done with simultaneous use of water to kill the bug dust; and to prohibit removal of methane accumulations while the working shift is in the mine.

OBSERVANCE OF MINING REGULATIONS

Although several of the coal companies have tried to adhere to the spirit as well as the letter of the law and the regulations under the law, and in many instances have excellent and somewhat expensive safety methods, practices, and equipment not required by the law, there are undoubtedly mines where not even the letter of the law has been obeyed. Individual miners, and in some instances mine officials tell of mines where smoking has been done underground with more or less the consent of the operator. Open torches for welding, bonding, and other work have been used more or less generally and with the shift in the mine. Dynamite has been used ostensibly for blasting rock, but actually in shooting coal in some instances. Gas accumulations have been moved with the shift in the mine, and in some cases, sprinkling has been used to waft the gas into the ventilating current, notwithstanding the fact that this very poor practice resulted in the Castlegate explosion of 1924 with its 171 fatalities. More or less open abandoned places are unprotected by rock-dust, rock-dust barriers, sprinkling, or sealing. Rock-dusting, if done at all, is in many mines done in a perfunctory manner with insufficient dust or with poor distribution, or is not renewed when covered with coal-dust in explosive proportions. Use of water on cutting machines, or on coal at faces or sprinkling of nonrock-dusted haulage ways, returns, room necks, and other places is done inefficiently, and dry coal-dust is freely found in the lower part of rooms, in air courses, crosscuts, open abandoned workings, and on many nonrock-dusted haulage roads. Explosives are taken into the mine in excessive quantities and are not properly protected while in the mine, and are used in such large quantity per hole that the permissible or safety feature is destroyed. Flame safety lamps, supposed to be kept locked when underground, are opened underground to be relighted because the relighting devices are not kept in working order. While verification of some of these statements would be difficult, there is little doubt that there is foundation for them and good reason to believe that other violations of the regulations are more or less current practice.

On the other hand, many mining men who were skeptical of rock-dusting, yet complied with the regulations, now are dusting far beyond the requirements of the State and the cost is found to be less than that of adequate sprinkling. Some mines are carrying the rock-dusting so far into the interior of the mine that the barrier requirement is being waived. Of those who objected to the use of water on the mining-machine cutter chain, few now would abandon this practice even if permitted to do so. The order eliminating black powder affected very few mines. While black powder still has some advocates, its loss has caused so little inconvenience as to be negligible, and much of this inconvenience is a state of mind rather than a matter of fact. The elimination of fuse and squibs and of blasting during the shift was an actual benefit to every person concerned; moreover, it applied to but a small portion of Utah's coal mines, inasmuch as more than half of Utah's tonnage had been on the new basis for several years. The requirement of closed electric safety lamps for all mines, including the so-called nongassy mines, has been a decided practical success. Disapproval of the new system is negligible, as is shown from the fact that when a hearing was called by the State Industrial Commission in February, 1925, to discuss the advisability of modifying the closed-light order, no advocate of the open light appeared, and the hearing developed into a "love feast" in favor of closed light for all mines.

Utah, for more than a quarter of a century, has used widespread sprinkling of workings, probably to a greater extent than any other coal-mining region in the world, and the new regulations as to sprinkling merely made obligatory practices already largely in effect but chiefly optional. However, the new regulations caused much more extensive, and at the same time much more intensive use of water, especially at and near the faces; so assiduously was the water applied that the wet slack became difficult to screen, and as a consequence some companies now are neglecting the sprinkling in order better to satisfy consumers as to coal screening. Other mines, however, complying with the spirit as well as the letter of the law, use the water, regardless of its effect on coal screening and sizing. Two of the 11 so-called drastic regulations have been rather freely disobeyed or disregarded; one of these is the requirement that methane accumulations shall not be moved while the shift is in the mine; the other is that before track is pulled out of rooms, air courses, or other workings, loose coal and coal-dust must be loaded out. The moving of methane accumulations during the shift has been almost a general practice in coal mining; hence, it is difficult to change. However, it is very dangerous, has resulted in innumerable mine disasters, and, notwithstanding the opinion to the contrary, it is absolutely unnecessary. The practice certainly should be stopped.

The drastic regulations as to Utah coal mines have been in effect several years; while they caused additional expense in their initiation, there is every reason to believe that if enforced impartially the net result over a period of years would be a monetary saving rather than an extra charge. However, with but one State inspector for mines with about 3,500 men producing approximately 5,000,000 tons annually, under conditions so inherently dangerous as those in Utah's coal mines, it can readily be seen that the State inspection force is entirely inadequate; and in time the regulations will be a joke except with those operators who really are progressive and possessed of a conscience. The regulations are up-to-date, safe, sane, practical, even economical, but they should be strictly enforced on all engaged in coal mining in Utah, and thereby made a protection to those operators who really desire to have their mines safe, as against those who would, if allowed, sacrifice safety of mine and men to expediency or to their own opinions.

SUGGESTED IMPROVEMENTS IN SAFETY MEASURES

Many of the smaller mining companies in Utah have their individual safety specialties; on the other hand, some mines do as little as possible and yet show enough compliance with the regulations to avoid the disapproval of the inspector. The numerous factors that tend toward making it difficult to operate with safety in the coal fields of Utah, together with the fact that the State's coal-mine accident record, both as to individual accidents and as to disasters, is decidedly bad notwithstanding the many excellent safety practices, laws, and regulations in effect, indicate that much yet remains to be done to safeguard Utah's mines and miners; therefore, a few suggestions as to possible improvements are here given.

Mining Methods

1. There appears to have been little or no alteration or improvement in the general system of mining in Utah during the past 20 years; as a result, there is too much interconnection of mines, too much interconnection of different mine levels, with far too many open nonworking rooms, entries, and other places. The remedies are: Adoption of panel systems with but two, three, or four openings from each panel, separating each panel from all others in so far as possible. Room pillars should be pulled as soon as rooms reach their distance; where this can not be done, the open nonworking rooms, and as much as possible contiguous entry, pillar, and other open nonworking territory, should be sealed. In pulling pillars, greater care should be taken to establish and maintain a predetermined pillar line, and pillars should be pulled clean even when to do so may be costly. Entries from which rooms are turned should be little, if any, over 1,000 feet long; otherwise maintenance is likely to become costly, and the haulage ways, manways, and other openings would be dangerous before the region is worked out. Where nonworking territory must be kept

open, whether rooms, entries, or pillars, this open nonworking territory should be kept well ventilated, well watered, preferably by water sprays running continuously, or rock-dusted; in any event it should be well protected by rock-dust barriers as open nonworking territory is very little, if any, less dangerous than are working faces. No nonworking territory should be left open if it can be sealed.

Haulage

2. Haulage casualties occur much too frequently in Utah coal mines; a few possible precautionary measures are:

Long, steep inclines on which men are hauled should be equipped with safety man trips, so that if a rope, coupling, or drawbar should break, automatic devices will stop the trip. If this is not done, it is only a question of time until there will be very serious disasters on these inclines.

Bare trolley wires carrying 250 to 500 volts direct current should be kept well boxed where the wire is less than 7 feet above the rail; this is usually held to be impracticable, but some metal mines have miles of effectively boxed trolley lines.

Haulage-entry grading is too frequently held to be dead work and a luxury; it is necessary, pays well, and is a wonderful safety precautionary measure.

In general, the pit cars and grades are far too heavy and dangerous for animal haulage; mine workings should be planned to use permissible storage-battery locomotives for gathering purposes. It, however, seems to be anything but safe practice to put trolley locomotives, even the crab or reel type, to the face of workings known to give off methane; this type of locomotive should not go into the rooms or pillars of workings with dust as inflammable as that found in Utah's mines, even if no methane is known in such places.

The open-end gate type of pit car is completely out of date in efficient coal mining, is wasteful, and is decidedly dangerous; nothing but the no-gate type of pit car should be allowed in Utah coal mines.

Blasting

3. Blasting practice in Utah is decidedly good, but is deficient in some respects.

No explosive should be allowed inside when the shift is in the mine. The shot-firers, who would thus carry in the explosive and load and tamp as well as fire all shots after departure of the working shift, should be required to have certificates of competency after having passed an examination, which should be at least as searching as the examination for fire bosses.

While nothing but permissible explosives are supposed to be used for shooting coal in Utah's coal mines, some dynamite, ostensibly for shooting rock, is being used to shoot coal or coal and rock together. Dynamite should be wholly eliminated from Utah's coal mines because permissible explosives can be obtained which, when used correctly, will bring down any rock or any coal encountered.

Permissible explosives are not held to be safe or permissible when more than 1½ pounds, or approximately 3 sticks, are charged into a hole; as a matter of fact, as many as 6 sticks, and more, are being used in Utah mines because of lack of efficient supervision, or in some instances because of failure to drill enough holes. This use of excessive permissible explosive per hole is dangerous and is also certain to give an unnecessary amount of fines and shattered coal.

There is a possibility that where the surface electric shooting system is in use, the shot-firers do not go to the surface to fire the shots, as required. There should be established some method which will insure that the shot-firers do go to the surface before or while firing the shots; otherwise the system will be ineffective.

Where the surface shooting system is in use, the main shooting switch at the surface should be so constructed that electrical contact is automatically maintained for but a fraction of a second; there should also be definite assurance that the main shooting switch will not be thrown in a second time unless there has been complete underground inspection and rearrangement of underground shooting switches and other accessories.

Ventilation

4. Ventilation practice in Utah coal mines is above the average, but there are serious defects:

Doors on haulage roads indicate a poor ventilation system; this is likely to be decidedly serious in gassy mines. Ventilation should be planned so that overcasts, regulators, and other means will eliminate doors from haulage roads, or even from most of the main manways.

Too many doors, stoppings, and other appliances in Utah mines of a more or less permanent nature are constructed of brattice cloth, wood, or other inflammable material.

Small electrically driven booster fans with tubing are being used increasingly in coal mines to ventilate dead ends. This indicates a failure or breaking down of the general ventilation system. Electric motors are very dangerous in gassy mines, and unless great care is exercised in placing them, and also in starting and stopping them, a disaster is likely to occur.

Air courses that are not haulage ways (and some air courses that are haulage ways) are allowed to become clogged, or nearly so, with rock or coal falls, water, or debris to such an extent that air flow is greatly impeded, if not practically stopped. One Utah company, by cleaning a few of its airways, increased the mine air flow by more than one-third.

Search for matches and patent lighters is not made as frequently or as rigidly as this safety feature deserves; it is said that in some coal mines, the mine officials wink at smoking underground. This is decidedly dangerous, besides being a defiance of the law. Several recent coal-mine explosions in closed-light mines have been caused by miners smoking; matches are often found on the bodies recovered.

It seems probable that flame safety lamps are being opened underground and relighted by open-flame matches; in several instances, flame safety lamps have been found with a defective relighting device; hence, they could have been relighted underground only by opening the lamp and lighting with a match. Some system should be devised at each mine to have all the flame safety lamps inspected at least once each week by some reliable person other than the user, even though the user is the fire boss, foreman, superintendent, or other official.

Electricity

5. Undoubtedly, electricity constitutes the greatest probable source of danger in coal mines generally, underground electrical installation are anything but safely or efficiently placed or maintained.

Few underground workers, whether miners or officials, are sufficiently well informed regarding electricity to be able to give an adequate opinion as to the safety of electric wiring, hoisting, pumping, haulage, coal-cutting, or other installations; this is particularly true of inspectors, whether working for the Federal Government, State, or the companies themselves. A competent electrical inspector should be provided by the State, and, if possible, he should have experience in coal mines as well as a thorough familiarity with electricity and its dangers.

In most coal mines, electric wiring is neglected in back entries or out-of-the-way places, frequently also, near the faces and in main haulage or travel roads. This is poor policy, as defective wiring in mines is even more dangerous than in city houses; as a matter of fact, mine wiring should be more carefully placed and maintained than surface or house wiring. Utah's coal mines have much defective wiring; this is true especially of shooting wires in rooms and in entries near the face.

It is inconsistent to require closed lights for miners yet allow use of the open, nonpermissible, electric coal-cutting and drilling equipment at faces. It would be advisable to confine future installations of electrical equipment, even in nongassy mines, to the permissible variety. Where methane is known to occur, if only in small quantity, nonpermissible electrical machinery should be withdrawn and permissible equipment substituted and maintained in permissible condition.

The open bare places on power wires to fasten the nips of the mining-machine trailing cable should be kept covered and held outside the last cross-cut. Even then they should be placed as near the floor as possible, rather than near the roof. A much better practice, however, is to have enclosed connectors and thus eliminate all danger from contact with bare spots or timbering or from open arcing or mechanized mining.

Supervision

6. Supervisory force in coal mines of Utah, as well as in most other coal-mining States, appears not to be as efficient in safety as it should, so the following suggestions are offered:

(a) Utah should have at least two general coal-mine inspectors and one inspector of coal-mine electrical equipment; these inspectors should be on a civil-service basis, should be appointed after having passed a difficult examination, both physically and mentally; and should be reexamined about every five years.

(b) All shot-firers, fire bosses, mine foremen, mine superintendents, and general superintendents should be required to have certificates of competency after having passed an examination involving both mental and physical tests as to knowledge of mines and mining and ability to do the necessary underground work. These certificates should be renewable every five years after a similar examination has been passed. This seems drastic, but it might aid in eliminating from official positions many men unfit, either physically or mentally, to hold those positions.

CONCLUSION

In general, safety practices in Utah's coal mines are better than those observed in coal mines of other States, but Utah's coal mines have so many inherent natural hazards that they demand much better safety practices than mines of other States. There should certainly be no letting down of the bars; rather, those bars should be built higher and made more difficult to get through or around or over.

Div. U.S. Govt.